PCT WORLD INTELLECTUAL PROPERTY ORGANIZATION
International Bureau

INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 5 :
C11D 1/66, 3/16, 3/22
C11D 3/38, 3/382

A1

(11) International Publication Number: WO 91/13138

(43) International Publication Date: 5 September 1991 (05.09.91)

(21) International Application Number: PCT/US91/01426

(22) International Filing Date: 1 March 1991 (01.03.91)

(30) Priority data:
488,151 2 March 1990 (02.03.90) US

(71) Applicant: THE DOW CHEMICAL COMPANY [US/US]; 2030 Dow Center, Abbott Road, Midland, MI 48640 (US).

(72) Inventor: CONKLIN, Jerry, R. ; 2018 Brookfield Drive, Midland, MI 48640 (US).

(74) Agent: SCHENIAN, John, R.; The Dow Chemical Company, P.O. Box 1967, Midland, MI 48641-1967 (US).

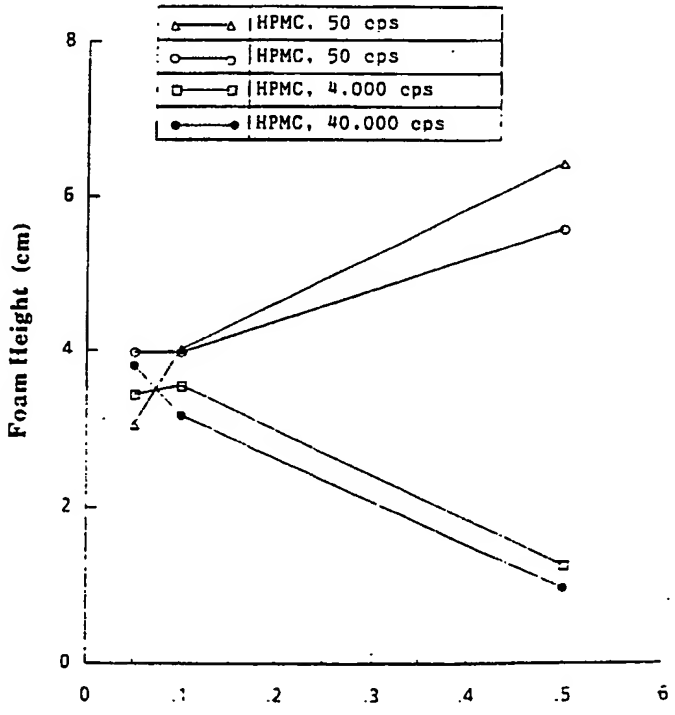
(81) Designated States: AT (European patent), BE (European patent), CA, CH (European patent), DE (European patent), DK (European patent), ES (European patent), FR (European patent), GB (European patent), GR (European patent), IT (European patent), JP, LU (European patent), NL (European patent), SE (European patent).

Published
With international search report.

(54) Title: USE OF LOW-VISCOSITY GRADES OF CELLULOSE ETHERS AS LATHER-ENHANCING ADDITIVES

(57) Abstract

Use of low-viscosity grades of surface active, nonionic cellulose ethers possessing inverse water solubility (with respect to temperature) as lather enhancers for lather-producing products. Such cellulose ethers include methylcellulose, methylethylcellulose, hydroxypropyl methylcellulose, hydroxypropyl cellulose, and hydroxyethyl methylcellulose. The specific functional contribution of the cellulose ethers of the present invention is that of imparting a lubricious, dense, stable, and voluminous foam during use of the product.



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USE OF LOW-VISCOSITY GRADES OF CELLULOSE ETHERS AS LATHER-ENHANCING ADDITIVES

This invention pertains to the use of cellulose ethers in lather-producing consumer and/or industrial compositions.

The use of high-viscosity grades of cellulose ethers in lather-producing consumer and/or industrial products is well known. The primary function of the cellulose ether in such uses is to increase product viscosity.

It is also known that a secondary use benefit of the cellulose ether is that of foam stabilization and increased lather lubricity. However, one is prevented from taking full advantage of such secondary attributes when excessive viscosity development accompanies use. Indeed, at use levels exceeding 1 to 2 weight percent in a formulation, high-viscosity grades of cellulose ethers may impart undesired properties such as stringiness, undesirable tactile properties, or such a high-viscosity that an otherwise useful product may be rendered undesirable.

Low-viscosity grades of cellulose ethers have not been used in cleaning or foaming products because they were recognized by those skilled in the art to be

inefficient thickeners. Their use for thickening was not cost effective, since considerably greater quantities are required for thickening than is the case with high-viscosity grades.

Some use of low-viscosity grades of cellulose ethers is known in certain consumer or industrial products. The specific function is that of a dispersant, binder, emulsifier, or soil anti-redeposition agent as exemplified respectively in certain hair styling/conditioner preparations, make-up, cosmetic creams/lotions, and detergents/cleaners. With the exception of detergents and cleaners, these are predominantly non-cleansing, non-foaming applications. In industrial and household detergents and cleaners, the use of cellulose ethers is known to prevent reattachment of removed soil to various surfaces and the effective use concentration in the formulated product is typically less than 0.1 weight percent.

High-viscosity grades of cellulose ethers normally used to thicken lather-producing consumer or industrial products may slightly decrease the final product's spontaneous or flash-foam tendencies.

Salon-type shampoo formulas often use 15 to 20 percent active surfactant plus 2 to 4 percent fatty alkanolamide which is a concentration sufficient to exhibit excellent flash foaming. The undesirable consequence of this common type of formulation is excessive oil stripping from the hair which is due to excessive detergency. If formulators decrease active surfactant content, the product suffers from poor foaming properties.

The present invention solves the above problems by disclosing a method for enhancing lather performance during the use of a lather-producing product by the use of a surface-active, nonionic cellulose ether possessing inverse water solubility relative to temperature, by using compositions which impart desired foam stabilization without suppressing foam volume.

The present invention is a method for enhancing lather performance during the use of a lather-producing product comprising incorporating a surface-active, nonionic cellulose ether possessing inverse water solubility relative to temperature into a lather--producing product to make a modified lather-producing product, wherein the incorporated cellulose ether has a viscosity ranging from 0.1 centipoise up to 400 centipoise in a 2 weight percent aqueous solution at 20°C, and wherein the incorporated cellulose ether is used in an amount effective to produce a desired lather performance level during use of the modified lather--producing product.

The invention consists of the use of low-viscosity grades of surface active, nonionic cellulose ethers possessing inverse water solubility (with respect to temperature) as lather enhancers for lather-producing products. Such cellulose ethers include methylcellulose, methylethylcellulose, hydroxypropyl methylcellulose, hydroxypropyl cellulose, hydroxyethyl methylcellulose, and mixtures thereof. In the practice of the present invention, a particular viscosity range of these cellulose ethers has been found to exhibit unexpected lather-enhancing properties in lather-producing products. The specific functional contribution of the cellulose ethers of the present

invention is that of imparting a lubricious, dense, voluminous foam that persists over a wide range of use temperatures.

Use of low-viscosity grades of surface active, nonionic cellulose ethers possessing inverse water solubility will enable formulators of lather-producing products to incorporate such cellulose ethers over a wider concentration range without concern for large undesired changes in product rheology or viscosity. Use of low-viscosity grades of the cellulose ethers of the present invention has been found to be much preferred when seeking only the development of lather-enhancing properties with a minimum of thickening attributes. Surprisingly, low-viscosity grades of the cellulose ethers of the present invention are superior as lather--enhancing agents to high-viscosity grades of the same cellulose ethers.

The use level of low-viscosity grades of the cellulose ethers of the present invention can be selected based on desired foaming performance levels. The use of such low-viscosity grade cellulose ethers has been discovered to impart desired foam stabilization much like their high-viscosity grade homologues but surprisingly without suppressing foam volume. Use of the cellulose ethers of the present invention would also allow for reduction of surfactants without loss of highly valued foam volume and stability.

Those products which may be modified by the present invention include any such product which is desired to exhibit lather or foam. Examples of lather--producing consumer and/or industrial products include shampoos, liquid hand soaps, bath products, liquid hand

dish soaps, shaving creams, laundry detergents, and hard surface cleaners. Typically, such lather-producing products frequently contain fragrances, primary and secondary surfactants, preservatives, and inorganic salts. The lather-producing products which are useful in the present invention must be compatible with cellulose ether-based additives. It is believed that the present invention could be used in both aerosol lather-producing products and non-aerosol lather--producing products, such as liquids, gels, or creams.

In the present specification and claims, the term "lather-producing product" is employed to designate a lather-producing consumer and/or industrial product which has not heretofore been formulated with a lather--enhancing low-viscosity cellulose ether of the present invention. By the term "modified lather-producing product" is meant a lather-producing consumer and/or industrial product which has been formulated with a lather-enhancing low-viscosity cellulose ether of the present invention.

Those cellulose ethers useful in the present invention as lather enhancers are low-viscosity grades of surface active, nonionic cellulose ethers possessing inverse water solubility (with respect to temperature). Such cellulose ethers include methylcellulose, methylethylcellulose, hydroxypropyl methylcellulose, hydroxypropyl cellulose, and hydroxyethyl methylcellulose. The preferred cellulose ethers of the present invention are methylcellulose, hydroxypropyl methylcellulose, and hydroxypropyl cellulose, due to such cellulose ethers being more hydrophilic and more compatible with other ingredients frequently found in consumer and industrial products. The most preferred

cellulose ethers of the present invention are hydroxypropyl methylcellulose and hydroxypropyl cellulose.

Methylcellulose, methylethylcellulose, hydroxypropyl methylcellulose, hydroxypropyl cellulose, and hydroxyethyl methylcellulose ethers are classes of cellulose ethers which have long been used in many industries as viscosity control agents, emulsifiers, and binding agents. The cellulose ethers which are useful in the present invention are those which impart a lather-enhancing property to lather-producing products over a wide range of use temperatures. These particular cellulose ethers help a modified lather-producing product to unexpectedly increase the lather or foam volume, lather stability, lather lubricity, lather density, and/or lather density of the modified product upon use, when compared to the performance of other products, particularly those using other types of cellulose ethers.

The cellulose ethers used in the present invention may be prepared by any of a number of known methods. Generally, a specific cellulose ether is prepared by the formation of an alkali cellulose by the addition of sodium hydroxide to a slurry of cellulose floc in a diluent. The alkali cellulose is then reacted with an appropriate alkylating agent, under pressure. Thereafter, the slurry is neutralized and the product is extracted, dried, and ground.

The particular cellulose ethers which are useful in the present invention are those which are of a low-viscosity grade. By "low-viscosity grade" is meant those cellulose ethers that, when in a 2 weight percent

aqueous solution, exhibit a viscosity at 20°C ranging from 0.1 centipoise (cps) to 400 cps. Preferably, the cellulose ethers, when in a 2 weight percent aqueous solution at 20°C, exhibit a viscosity ranging from 0.5 cps to 200 cps. Most preferably, the cellulose ethers, when in a 2 weight percent aqueous solution at 20°C, exhibit a viscosity ranging from 3 cps to 100 cps. Conversely, by "high-viscosity grade" is meant those cellulose ethers that, when in a 2 weight percent aqueous solution, exhibit a viscosity at 20°C greater than 400 cps. Such viscosities are measured by conventional methods, wherein a 2 weight percent aqueous solution of the cellulose ether is measured using Ubbelohde capillary tubes at 20°C.

It has also been discovered that the lather--enhancing performance of the cellulose ethers of the present invention can be affected by the molecular weight distribution of the cellulose ether. The molecular weight distribution of a particular cellulose ether is affected by the production method used to make the cellulose ether. As such, two similar cellulose ethers of the present invention, of the same type and viscosity grade, might exhibit measurable differences in lather-enhancing capabilities from each other, even though each cellulose ether is capable of performing effectively under the present invention.

Examples of methylcellulose and hydroxypropyl methylcellulose include those commercially available as METHOCEL™, available from The Dow Chemical Company, and METOLOSE™ and PHARMACOAT™, available from the Shinetsu Chemical Company, Tokyo, Japan.

In the present specification and claims, the term "lather enhancer" is employed to designate a product additive which results in improvements in lather density, stability, lubricity, texture, and/or volume.

In the present specification and claims, the term "desired lather performance level" is employed to designate the amount or level of lather exhibited by an individual product. Such desired lather performance levels will generally be predetermined by the formulators of the lather-producing product. However, such lather performance levels will generally be dictated by specific consumer or industrial need requirements and, as such, will vary from product to product.

The minimum amount of the cellulose ethers of the present invention, or mixtures thereof, to be added to an individual lather-producing product will be that amount of the cellulose ethers necessary to provide the desired lather performance levels for the product. The maximum amount of the cellulose ethers of the present invention to be added to an individual lather-producing product will be dictated by such considerations as cost, rheology control, and the need to allow for the sufficient presence of the active ingredients of the product.

Due to the above considerations, the cellulose ethers of the present invention, and mixtures thereof, will generally be used in amounts ranging from 0.1 weight percent to 10 weight percent based on the total weight of the modified lather-producing product. Preferably, the cellulose ethers of the present invention will be used in amounts ranging from

0.5 weight percent to 8 weight percent based on the total weight of the modified lather-producing product. Most preferably, the cellulose ethers of the present invention will be used in amounts ranging from 1 weight percent to 6 weight percent based on the total weight of the modified lather-producing product.

In the present specification and claims, the term "use temperature" is employed to designate any temperature encountered in use of the modified lather-producing product. Generally, such use temperatures will be between 0°C and 100°C for aqueous modified lather-producing products.

In a preferred embodiment of the invention, the low-viscosity grade cellulose ether is present in a modified lather-producing composition in an amount which increases lather volume by at least 20 percent, more preferably at least 50 percent, relative to the lather volume of an otherwise identical lather-producing composition which does not contain the low-viscosity grade cellulose ether. Lather volume can be conveniently determined by the test procedure set forth in Example 1 hereafter.

The following examples illustrate the present invention and the manner by which it can be practiced but, as such, should not be construed as limitations upon the overall scope of the same.

Example 1

Two percent by weight aqueous stock solutions of different viscosity grades of hydroxypropyl methylcelluloses are made up and subsequently diluted to 0.5 weight percent, 0.10 weight percent, and 0.05 weight

percent aqueous solutions with deionized water. The viscosity grade for each hydroxypropyl methylcellulose is determined for a 2 weight percent aqueous solution at 20°C.

A standard shake test method is employed on 50 ml samples of aqueous solution using 250 ml graduated cylinders. The samples are maintained at 20.0° ± 2.0°C in a constant temperature water bath. The samples are shaken vertically and uniformly five times and the initial foam height is then measured. Foam heights are measured from the liquid-foam interface to the top of the column of generated foam. A minimum of three tests are made on like aqueous solutions and the average value reported. The results of these tests are shown in Table I and Figure 1.

TABLE I

Initial Foam Heights of Low and High Viscosity Grade Hydroxypropyl Methylcellulose Ethers at Varying Aqueous Solution Concentrations (Testing done at 20°C).

Sample Concentration (weight percent)	Hydroxypropyl Methylcellulose Viscosity Grade (Measured at a 2 Weight Percent Aqueous Solution at 20°C)			
	50 cp*	50 cp*	4,000 cp	40,000 cp
0.05	3.6 cm	4.0 cm	3.5 cm	3.8 cm
0.1	4.0 cm	4.0 cm	3.6 cm	3.2 cm
0.5	6.5 cm	5.6 cm	1.3 cm	1.0 cm

*Same viscosity grades, but different molecular weight distributions due to different production processes.

As can be seen from Table I and Figure 1, initial foam height increases with increasing concentration for low molecular weight hydroxypropyl methylcellulose solutions. Conversely, initial foam height decreases with increasing concentration for high molecular weight solutions. Initial foam heights tend to plateau as solutions become dilute over the entire viscosity grade range.

Example 2

Test Shampoos A and B are examples of the invention and use low-viscosity grades of hydroxypropyl methylcellulose (HPMC) as lather-enhancing agents. Test Shampoo C uses a fatty alkanolamide (lauric diethanolamide) lather enhancer which typifies the prior art, and is meant to serve as a comparison. The ingredient formulation of each test shampoo is shown in Table II.

TABLE II
Formulations of Test Shampoos
(All Values Given as Weight Percents)

Ingredient	Test Shampoo A	Test Shampoo B	Test Shampoo C (Comparison)
Ammonium Lauryl Sulfate	10.00	10.00	10.00
Lather Enhancer: HPMC, 50 cps grade	3.00	--	--
Lather Enhancer: HPMC, 6 cps grade	1.00	4.00	--
Lather Enhancer: Lauric Diethanolamide	--	--	4.00
Preservative	0.10	0.10	0.10
Citric Acid	0.03	0.02	0.11
Sodium Chloride	0.34	2.00	0.50
Water	85.23	83.58	84.99
Fragrance	0.30	0.30	0.30

These three test shampoos are tested at 100 times dilution in a mechanical lather generating machine in the presence of an artificial sebum (2 weight percent based on a combined test shampoo/artificial sebum solution) and moderately hard water at 40°C. The results of these studies are given in Table III.

TABLE III

Test Shampoo Lather Volume Data

Test Shampoo	Lather Volume* (ml)
A	270
B	290
C (Comparison)	165

*Calculated mean value of duplicate experiments

The primary objective of a shampoo formulation is to provide cleansing of the hair. Foaming action of shampoo is perceived by many consumers to be a visual cue of performance. Test Shampoos A and B outperform the standard Test Shampoo C in lather volume by a significant and considerable degree.

Artificial Sebum

The artificial sebum used in the examples consists of the ingredients shown in Table IV. The artificial sebum was selected to represent the conditioner residue often found on hair as well as some of the known naturally occurring oleaginous components. The nature of these artificial sebum ingredients is such that their addition to an otherwise lathering surfactant solution results in a notable decrease of lathering ability. Therefore, the artificial sebum ingredients fairly represent the delathering tendencies of naturally occurring sebum found on hair. The lathering response of a cleaning solution is often taken as a measure of its cleaning ability and is consequently an important visual cue to perceived performance.

TABLE IV
Composition of Artificial Sebum Formulation
(All Values Given as Weight Percents)

White Rain® Baby Conditioner	96.0
Cetyl alcohol	1.6
Triolein	0.8
Squalene	0.8
Cholesterol	0.8

NOTE: White Rain® is a trademark of The Gillette Company

The ingredients listed by the manufacturer of the hair conditioner product, The Gillette Company, include the following (in order of decreasing concentration): water, stearalkonium chloride, ceteth-2, dimethyl stearamine, phenoxyethanol, glyceryl stearate, citric acid, sodium chloride, stearyl alcohol, and fragrance. Eight grams of the artificial sebum formulation are added to each 392 grams of 100 times diluted test shampoo solution prior to addition to the lather test cell.

Lather Test Cell

A jacketed 1000 ml cylindrical glass test cell having an internal diameter of 8 cm and a height of 22 cm is used as the test cell. A large bottle brush with cylindrically-configured bristles is inserted into the bottle so that the brush's bristled end nearly touches the bottom of the glass cell. The entire array is vertically oriented and filled with 400 ml of a diluted test shampoo/artificial sebum solution. The round handle of the bottle brush is connected to a connecting rod extending parallel to the face of a motor driven disc. The connecting rod is attached at one end

to an eccentric post extending normal to the face of the disc, the eccentric post being journalled within a mount and rotating therein as the disc turns, giving the connecting rod reciprocal motion. The connecting rod is provided with a guide to provide a vertical reciprocal stroke with an amplitude of 5.08 cm (2 in.). The disc is turned at 120 revolutions per minute providing 120 cycles per minute of the bottle brush. The temperature of the test cell is maintained at 40°C by an outer glass jacket connected to an external bath.

Lather Test Procedure

The test shampoo and artificial sebum are loaded into the cell and brought up to the test temperature. The motor is started and the vertically oriented reciprocating action of the bottle brush is maintained for two minutes and then turned off. At this point the lather volume generated above the liquid meniscus is determined from the graduations on the cell and recorded.

Example 3

Two percent by weight aqueous stock solutions of different viscosity grades of methylcellulose are made up and subsequently diluted to 0.5 weight percent, 0.10 weight percent, and 0.05 weight percent aqueous solutions with deionized water. The viscosity grade for each methylcellulose is determined for a 2 weight percent aqueous solution at 20°C.

A standard shake test method is employed on 50 ml samples of aqueous solution using 250 ml graduated cylinders. The samples are maintained at 20.0° ± 2.0°C in a constant temperature water bath. The samples are shaken vertically and uniformly five times and the

initial foam height is then measured. Foam heights are measured from the liquid-foam interface to the top of the column of generated foam. A minimum of three tests are made on like aqueous solutions and the average value reported. The results of these tests are shown in Table V.

TABLE V

Initial Foam Heights of Low and High Viscosity Grade Methylcellulose Ethers at Varying Aqueous Solution Concentrations (Testing done at 20°C)

Sample Concentration (weight percent)	Methylcellulose Viscosity Grade (Measured at a 2 Weight Percent Aqueous Solution at 20°C)	
	15 cp	4,000 cp
0.05	3.6 cm	3.0 cm
0.1	4.9 cm	2.7 cm
0.5	8.7 cm	1.6 cm

As can be seen from Table V, initial foam height increases with increasing concentration for low molecular weight methylcellulose solutions. Conversely, initial foam height decreases with increasing concentration for high molecular weight solutions. Initial foam heights tend to plateau as solutions become dilute over the entire viscosity grade range.

1. A method for enhancing lather performance during the use of a lather-producing product comprising incorporating a surface-active, nonionic cellulose ether possessing inverse water solubility relative to temperature into a lather-producing product to make a modified lather-producing product, wherein the incorporated cellulose ether has a viscosity ranging from 0.1 centipoise up to 400 centipoise in a 2 weight percent aqueous solution at 20°C, and wherein the incorporated cellulose ether is used in an amount effective to produce a desired lather performance level during use of the modified lather-producing product.

2. The method of Claim 1 wherein the incorporated cellulose ether is methylcellulose, methylethylcellulose, hydroxypropyl methylcellulose, hydroxypropyl cellulose, hydroxyethyl methylcellulose, or a mixture thereof.

3. The method of Claim 2 wherein the incorporated cellulose ether is methylcellulose, hydroxypropyl methylcellulose, hydroxypropyl cellulose, or a mixture thereof.

4. The method of Claim 3 wherein the incorporated cellulose ether is hydroxypropyl methylcellulose, hydroxypropyl cellulose, or a mixture thereof.

5. The method of Claim 1 wherein the incorporated cellulose ether has a viscosity ranging from 0.5 centipoise up to 200 centipoise in a 2 weight percent aqueous solution at 20°C.

6. The method of Claim 5 wherein the incorporated cellulose ether has a viscosity ranging from 3 centipoise up to 100 centipoise in a 2 weight percent aqueous solution at 20°C.

7. The method of Claim 1 wherein the incorporated cellulose ether is used in an amount ranging from 0.1 weight percent to 10 weight percent based on the total weight of the modified lather-producing product.

8. The method of Claim 7 wherein the incorporated cellulose ether is used in an amount ranging from 0.5 weight percent to 8 weight percent based on the total weight of the modified lather-producing product.

9. The method of Claim 8 wherein the incorporated cellulose ether is used in an amount ranging from 1 weight percent to 6 weight percent based on the total weight of the modified lather-producing product.

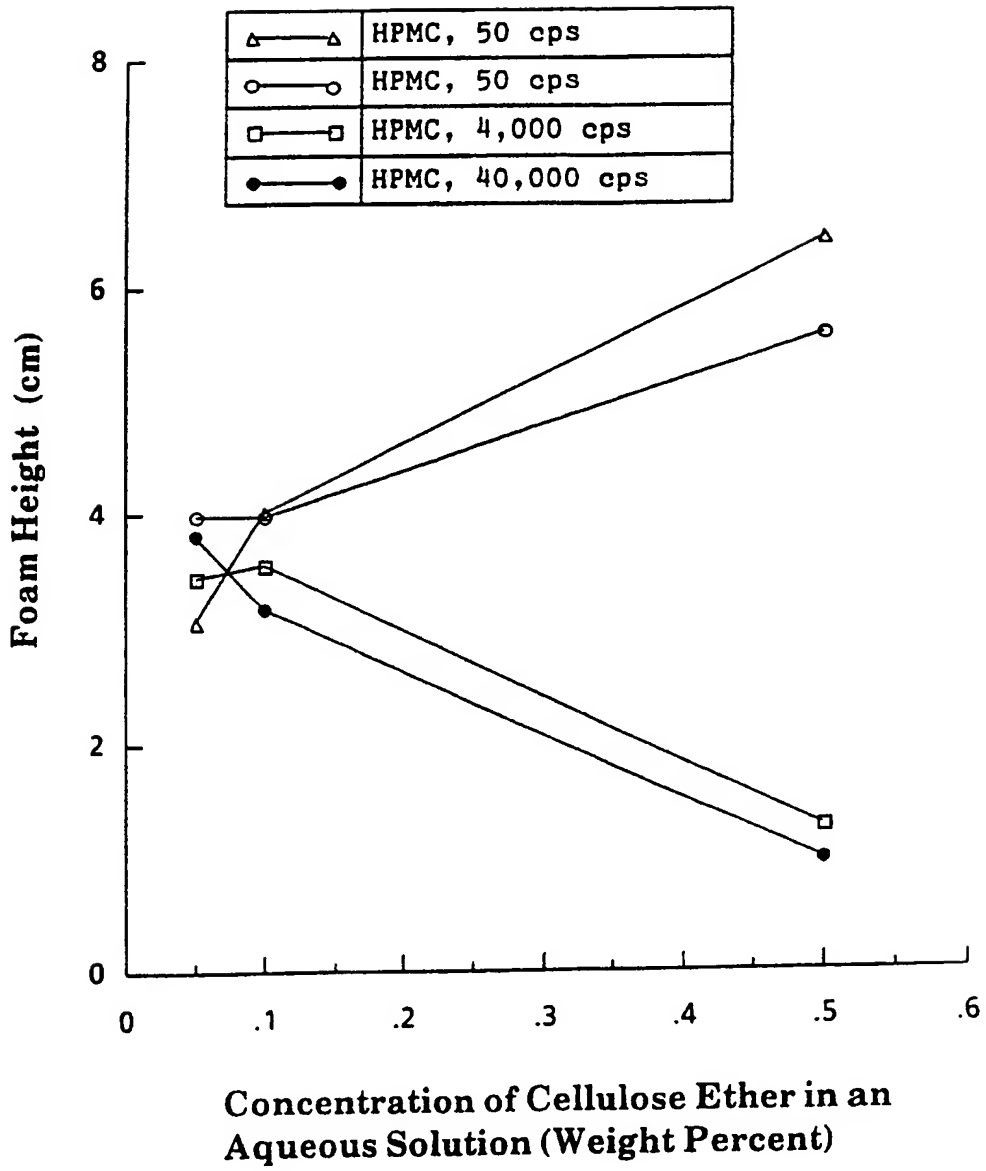
10. The method of Claim 1 wherein the cellulose ether is present in an amount which increases lather volume by at least 20 percent relative to an otherwise

identical lather-producing product composition that does not contain the cellulose ether.

11. The method of Claim 10 wherein the cellulose ether is present in an amount which increases lather volume by at least 50 percent relative to an otherwise identical lather-producing product composition that does not contain the cellulose ether.

12. The method of Claim 1 wherein the modified lather-producing product is a shampoo, hand soap, shaving cream, laundry detergent, dish soap, or hard surface cleaner.

FIG. 1


HPMC, 50 cps
HPMC, 50 cps
HPMC, 4,000 cps
HPMC, 40,000 cps
Foam Height (cm)
8
6
4
2
0
0
.1
.2
.3
.4
.5
.6
Concentration of Cellulose Ether in an Aqueous Solution (Weight Percent)

INTERNATIONAL SEARCH REPORT

International Application No PCT/US91/01426

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all)

According to International Patent Classification (IPC) or to both National Classification and IPC

IPC(5) CL -C11D 1/66, 3/16, 3/22, 3/38, 3/382
US CL 252/174.17,117,553,546,551,DIG.2,DIG13

II. FIELDS SEARCHED

Minimum Documentation Searched

Classification System	Classification Symbols
US CL	252/174.17,117,553,546,551, DIG 2, DIG 13

Documentation Searched other than Minimum Documentation to the Extent that such Documents are included in the Fields Searched

III. DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of Document, with indication, where appropriate, of the relevant passages	Relevant to Claim No.
Y	US,A, 4,532,067 (PADRON ET AL) 30 JULY 1985 Col. 1, line 67 - col. 2, line 14 Col. 2, lines 40-41 and col. 6, lines 1-15	1-12
Y	US, A, 4,654,207 (PRESTON) 31 MARCH 1987 Col. 12, line 5-7	1-12
Y	US, A, 4,511,497 (EHRLICH) 16 APRIL 1985 Col. 2, lines 1-6 and 20-26	1

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IV. CERTIFICATION

Date of the Actual Completion of the International Search	Date of Mailing of this International Search Report
15 MAY 1991	06 JUN 1991
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Form PCT/ISA/210 (second sheet) (May 1986)